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Ewa Niesiołowska (1941–2013)
In Memoriam

Pod redakcją
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Spis treści

Dla Pani Ewy

Wprowadzenie

Introduction

W 2023 r., dokładnie 6 stycznia, minęło 10 lat od kiedy nie ma z nami nieocenionej i drogiej nam Koleżanki z pracy, kuzynki, przyjaciółki mgr Ewy Niesiołowskiej-Śreniowskiej. Całą swoją karierę zawodową, wliczając w to czas nauki, spędziła w Muzeum Archeologicznym i Etnograficznym w Łodzi. W czasie studiów w latach 1959–1964 ówczesna Katedra Archeologii Polski swoją siedzibę miała właśnie na placu Wolności w Muzeum. To tu pod skrzydłami profesora Konrada Jażdżewskiego, Marii i Waldemara Chmielewskich oraz Lidii Gabałówny odkryła w sobie pasję do epoki kamienia. Z tego też powodu, przygotowując prezentowany tom, nie koncentrowaliśmy się na jednym okresie, lecz rozszerzyliśmy zakres tematyczny publikacji do epoki kamienia, co koresponduje z szerokimi i wszechstronnymi zainteresowaniami naukowymi Pani Ewy, która w czasie studiów pracowała na wielu stanowiskach z paleolitu i mezolitu, ale pracę magisterską napisała na podstawie neolitycznych materiałów kultury pucharów lejkowatych z Pikutkowa koło Brześcia Kujawskiego. Pracę podjęła jednak w Dziale Starszej i Środkowej Epoki Kamienia, świeżo opuszczonym przez M. i W. Chmielewskich w 1965 r. Przez ponad 45 lat przeszła całą ścieżkę kariery muzealnej, ale nie zdobywała kolejnych stopni naukowych. Mimo to była bardzo aktywna w środowisku „kamieniarzy" – jeździła na spotkania naukowe, uczestniczyła w konferencjach i odbywała staże krajowe i zagraniczne. Prowadziła badania na kilku stanowiskach, głównie z zabytkami mezolitycznymi, które na stałe weszły do kanonu publikowanych materiałów krzemiennych. Należy wspomnieć m.in. obozowiska w Osjakowie, Mokraczu oraz Aleksandrowie Łódzkim.

Ważnym etapem w życiu naukowym była wewnątrzmuzealna pomoc w opracowaniu materiałów z badań w Sarnowie, których nie udało się opublikować dr L. Gabałównie z powodu nagłej śmierci. Przeniosło to ponownie ciężar zainteresowań na kulturę pucharów lejkowatych. Na podstawie tych znalezisk do końca pracy w Muzeum Pani Ewa rozważała kwestie udziału kultury janisławickiej w genezie kultury pucharów lejkowatych oraz ogólne zagadnienia schyłku społeczności mezolitycznych. Przez wieloletni dostęp zarówno do zabytków krzemiennych z grobu w Janisławicach, jak i najstarszych materiałów krzemiennych z Sarnowa, Pani Ewa kilkukrotnie mogła się wypowiadać na łamach czasopism, będąc jedną z najlepszych specjalistek w tym temacie w Europie Środkowej. Pani Ewa chętnie dyskutowała z koleżankami i kolegami ze środowiska badaczy epoki kamienia, stąd prawie każdy, kto zajmuje się, bądź zajmował się archeologią w 2. połowie XX w. oraz w 1. dekadzie XXI w. znał Panią Ewę.

Obok niekwestionowanych sukcesów w archeologii Pani Ewa była przede wszystkim muzealniczką. Skrupulatnie inwentaryzowała materiały krzemienne, współpracowała przy wystawach oraz chętnie udostępniała muzealne materiały. Przez kilkanaście lat była kuratorką Zespołu Działów Archeologicznych w Muzeum w bardzo trudnym czasie tzw. „badań na autostradach". Z perspektywy ponad dekady od zakończenia tych prac terenowych, m.in. dzięki zaangażowaniu i poświęceniu Pani Ewy, można stwierdzić, że udało się te badania zrealizować w sposób wyjątkowy w skali Polski, a może i Europy. Dzisiaj materiały są zainwentaryzowane, spora część już jest opublikowana, a najciekawsze przedmioty są prezentowane na wystawach muzealnych zarówno stałych jak i czasowych. Pokazuje to, że dla swojego Muzeum Pani Ewa zrobiła naprawdę wiele. Teraz nam, koleżankom i kolegom z pracy czy przyjaciołom, pozostaje upamiętnić i rozpowszechnić Jej dzieła i osiągnięcia. Możemy to zrobić m.in. przez wydanie w 10 rocznicę śmierci publikacji poświęconej Pani Ewie.

Redakcja

On 6 January 2023, it will be 10 years since our esteemed dear colleague, cousin, and friend Ewa Niesiołowska-Śreniowska is no longer with us. She spent her entire professional career – including her time as a student – at the Museum of Archaeology and Ethnography in Łódź. During her studies from 1959 to 1964, the then Department of Polish Archaeology was based in the Museum at Plac Wolności. It was here, under the supervision of Professor Konrad Jażdżewski, as well as Maria and Waldemar Chmielewski and Lidia Gabałówna, that she discovered her passion for the Stone Age. We have defined such a general subject area – the Stone Age – on purpose, because while Ewa worked on many sites from the Palaeolithic and Mesolithic periods during her studies, she wrote her master's thesis on the Neolithic materials of the Funnel Beaker Culture from Pikutkowo near Brześć Kujawski. However, she took up a job in the Department of Old and Middle Stone Age newly vacated by Mr. and Mrs. Chmielewski in 1965. For more than 45 years thereafter, she went through the whole path of a museum career, but she did not earn any further academic degrees. Nonetheless, she was very active in the "stonemason" community, travelling to scientific meetings, attending conferences, and doing national and international internships. She personally surveyed several sites, mainly with Mesolithic occupations. The encampments at Osjaków, Mokracz, and Aleksandrów Łódzki, among others, have permanently entered the canon of published flint materials.

An important stage in Ewa's scientific life was her assistance in the compilation of materials from research at Sarnowo, which Dr Lidia Gabałówna

was unable to publish due to her sudden death. This shifted the focus of interest again to Funnel Beaker Culture. On the basis of these materials, until the end of her work at the Museum, Ms Ewa considered questions of the contribution of the Janisławice culture to the genesis of Funnel Beaker Culture and general issues of the decline of Mesolithic communities. Through many years of access to both the finds from the Janisławice grave and the oldest flint materials from Sarnowo, Ms Ewa was able to express herself several times on the pages of journals as one of the top specialists on this subject in Central Europe. She was keen to discuss importrant questions with her colleagues in the specialist community, so almost everyone who was or was involved in Stone Age archaeology in the second half of the 20th century and in the first decade of the 21st century knew Ewa.

Apart from her unquestionable success in archaeology, Ewa was first and foremost a museologist. She meticulously inventoried flint materials, collaborated on exhibitions and willingly provided access to museum materials. For more than a dozen years she was curator of the Archaeological Department Team at the museum during the very difficult time of the so-called "highway surveys". From the perspective of more than a decade since the conclusion of these field projects, it is thanks to, among other things, Ewa's commitment and dedication that this research has been completed in a way that is unique in Poland, and perhaps even in Europe. Today, the materials have been inventoried and many sites and assemblages have already been published. The most interesting items are on display in both permanent and temporary museum exhibitions. This shows that Ewa has really done a lot for her museum. It now remains for us – her colleagues and friends – to commemorate and disseminate Ms Ewa's work and achievements. One way we can do this is by publishing this volume dedicated to Ms Ewa on the 10th anniversary of her death.

Ewa Niesiołowska's Polish colleagues often addressed her as "Pani Ewa". Literally, this translates to "Miss Ewa" or in modern form, "Ms Ewa". The translation is imperfect, however. The word "Pani" followed by the first name is an affectionate Polish form of address used by friends and colleagues

that acknowledges an asymmetry of age/position/esteem. In English, however, addressing or referring to someone as "Miss" or "Ms" followed by a first name alone is unusual and may appear stiff and formal (or alternatively might be used to address a child.) It may not convey the warmth of the Polish usage. Nonetheless, many authors in this volume have chosen to translate "Pani Ewa" as "Ms Ewa", so even if the English form is not an exact fit, please consider it to be as affectionate as its Polish counterpart.

The editors

Peter Bogucki

Working Neolithic Landscapes in the Polish Lowlands

Dedicated to my dear cousin Ewa Niesiołowska,
who opened the door to Polish archaeology for me.

Introduction

This paper draws on over 40 years of research on Neolithic sites in north-central Poland to characterize "working landscapes" of the earliest farmers of the North European Plain (fig. 1). The definition of a "working landscape" used here is the "the routine landscape of daily life and the maintenance of households."[1] It was a visible and tangible manifestation of the consequences of everyday practical human behavior, generated primarily by subsistence activities and other economic tasks, in contrast to the "ritual landscape" generated by symbolic and ceremonial activities.

Farming settlement in north-central Poland between 5400 and 4000 BC is concentrated in a few regions, with some outlying sites. Along the lower Vistula, Kuyavia and Chełmno Land are areas of fertile ground moraine with many post-glacial relic landforms like kettle lakes and tunnel valleys. Similar soils and glacial features are found along the lower Oder in Pyrzyce Land

[1] As stated by Nicki Whitehouse and Rick Schulting in the session abstract for *Continuity or Change? Working Through Neolithic Landscapes,* 2006 European Association of Archaeologists meeting in Kraków, Poland, where the earliest version of this paper was presented.

and in adjacent parts of northeastern Germany. These areas attracted Neolithic pioneers of the Linear Pottery culture during the late sixth millennium BC. The range of Linear Pottery settlement has been extended to include the Chojnice area in the north (D. K. Płaza, personal communication) and the southern and southwestern edges of Kuyavia (*e.g.* A. Marciniak *et al.* 2015; P. Papiernik *et al.* 2017). After a possible hiatus, Neolithic settlement resumed during the fifth millennium BC. Settlements of the Brześć Kujawski Group of the Lengyel Culture dated between 4700 and 4000 BC occur not only in Kuyavia and Chełmno Land, but also in adjacent parts of Wielkopolska.

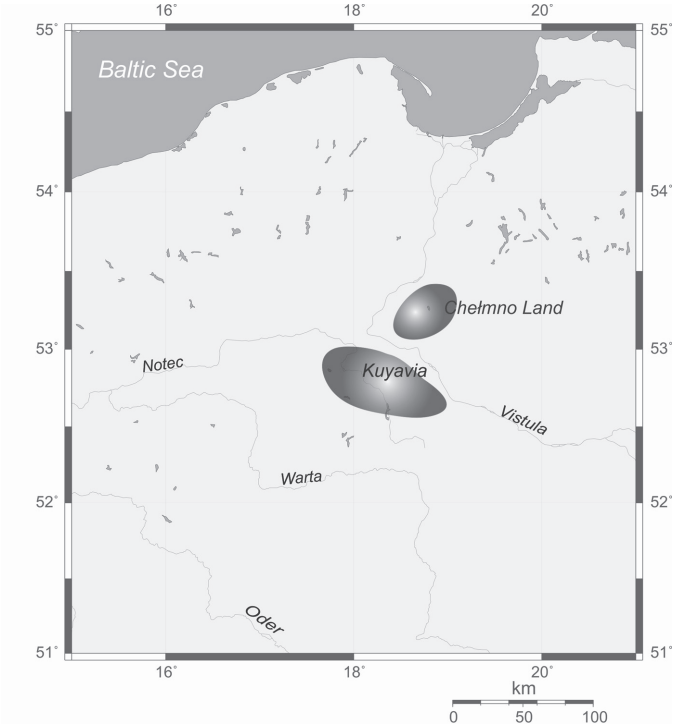

Fig. 1. Map of northern Poland showing main areas of Neolithic settlement discussed in this paper. Box indicates the part of southeastern Kuyavia in which the archaeological and palaeoecological localities discussed in this paper are found.
Ryc. 1. Mapa północnej Polski z zaznaczonymi głównymi obszarami osadnictwa neolitycznego, o których mowa w artykule. Archeologiczne i paleoekologiczne stanowiska na południowo-wschodnich Kujawach, o których mowa w artykule, zaznaczone zostały kwadratem.

Household Cycles and Landscapes

The Neolithic household can be considered to have been the primary unit of social and economic organization, the nexus for decision-making about the acquisition, allocation, and consumption of resources (P. Bogucki, R. Grygiel 2022, among many). Emilio F. Moran and Stephen D. McCracken (2004, 21), who study Amazonian frontier settlement, land use, and deforestation, stress the articulation between households and landscapes and argue that the landscape can be considered to be "a mosaic made up of households at different stages in their developmental cycles and with different initial endowments". Prior experiences, demographic composition, and decisions of households define the resulting landscape. The concept that the working landscape is the outcome of household decisions about land use, fertility, labor allocation, and requirements for both subsistence and social consumption leads motivates the approach taken in this paper.

A key determinant of how households define their landscapes is their internal demographic composition. The "household cycle" is an idealized model of household development over time (*e.g.* M. Fortes 1958). A common model presents a five-stage cycle:

1. Establishment – the new household, possibly still dependent on its parental household(s), builds a house and establishes a farm;
2. Expansion – the new household becomes clearly independent and children are born;
3. Consolidation – the household expands to its fullest point;
4. Fission – children begin to marry and leave the parental household, perhaps associated with relinquishment of control over household resources from the parental to the filial generation;
5. Decline – the final stage, which often contributes to the expansion stage of filial households if the parental household joins them.

As this idealized household moves through time, nearby households develop in parallel. Thus a community composed of multiple households has extremely dynamic demographic activity at the household level. Most

household models assume a two-generation structure. In Neolithic societies, these stages may not have been delineated sharply, especially if household development took place over three generations (for example, if children remained in their parental households after marriage and birth of their first children.) In polygynous households, different subsections of a single residential group might have been at several stages simultaneously. Even if idealized household models do not apply exactly to Neolithic societies in temperate Europe, the important point is that Neolithic households certainly experienced similar cyclical developmental processes tied to reproduction, ageing, and family structure.

Linear Pottery Pioneers

The earliest farmers of the Polish Lowlands were part of the expansion of farming throughout riverine interior central Europe by the Linear Pottery culture. Radiocarbon dates place their initial presence in Kuyavia, around 5400/5300 BC (R. Grygiel 2004; J. Pyzel 2021). Diaspora of farmers was the primary engine of agricultural dispersal in central Europe (P. Bogucki 2003; D. Hofmann 2020). It appears that lowland centers of Linear Pottery settlement were occupied initially in a multitude of small-scale colonization events over decades or even centuries rather than by mass migration or even repeated influxes from a common source region.

Over 40 years ago, I argued that lowland Linear Pottery settlements had a different character from those found on the loess (P. Bogucki 1979). In contrast to the large palimpsests of longhouses found throughout the loess zone, the lowland sites, as I saw them then on the basis of limited exposures, were small and poorly-delineated collections of features with occasional amorphous post structures. These seemed to be fairly short--term occupations of a somewhat "tactical" character rather than long-term commitments. Since then, many excavations, especially along the A-1 motorway corridor, have called this characterization into doubt. We can now speak of longhouses in the lower Vistula valley, most of which date to the

final two centuries of the sixth millennium BC. The most visible sites lie in the Smólsk – Kruszyn – Ludwinowo complex near Włocławek. Ludwinowo 7 has yielded traces of 33 houses, 14 of which are known from preserved posthole patterns and the rest inferred from characteristic associated features, occupied over multiple phases (J. Pyzel 2019). Houses have also been identified at other sites, so we now see that many lowland Linear Pottery sites represent long-term commitments to particular locations.

At the same time, however, we still need to see the lowland Linear Pottery sites for what they are not, particularly in comparison with later Neolithic settlements discussed below. With the possible exception of Ludwinowo 7 and a few other sites, we do not see palimpsest multi-phase occupations or sprawling settlements. Further away from the Vistula corridor, Linear Pottery sites are still small with minimal architectural elaboration. We have yet to find ditches or fortifications. Looking down from space, the relatively sparse Linear Pottery settlement of the lowlands would still appear considerably different from the dense settlement cells of the loess zone.

An important but often unasked question concerning the lowland Linear Pottery settlements is, "where are the graves?" Some skeletal burials have been identified in Linear Pottery features (R. Grygiel 2004, 366; J. Pyzel 2019, 26). But where are the numerous burials in cemeteries, in settlements, or in mass graves like those in the loess belt? Surely some Neolithic people died during the last centuries of the sixth millennium BC in the lowlands, so what might account for the absence of burials? Poor preservation conditions can be ruled out, for subsequent Neolithic settlements contain dozens of skeletal burials. Linear Pottery cremation burials are known from elsewhere in Europe, but in cemeteries and with diagnostic artifacts. If most lowland Linear Pottery occupations were of relatively short duration and with small populations, the number of deaths resulting in burials that (1) survived millennia of cultivation and disturbance and (2) could be found by archaeologists would be correspondingly low. The simplest explanation for the lack of Linear Pottery burials in the lowlands

is the stochastic relationship among population size, duration of occupation, frequency of death, probability of preservation, and probability of archaeological discovery.

Palaeoenvironmental research indicates a relatively low impact of Linear Pottery settlements on the surrounding environment. At Osłonki – Miechowice, pollen cores from biogenic sediments have been analyzed (D. Nalepka 2005; 2011; P. Bogucki *et al.* 2012). The portions of these cores corresponding to the sixth millennium BC contain well-preserved pollen with little mineral corrosion. Aside from the arboreal pollen, they contain isolated grains of cereal pollen and some grains of weed pollen. In other words, there is a faint signal of an agricultural presence but no evidence of a dramatic transformation of the pre-existing vegetation. At Smólsk, slope erosion at a kettle hole began during the nearby Linear Pottery occupation, but it continued with greater intensity during the fifth millennium BC (P. Kittel 2015).

Inhabitants of Linear Pottery settlements practiced agriculture and kept domestic animals. Carbonized archaeobotanical materials (A. Bieniek 2007; A. Mueller-Bieniek *et al.* 2016; A. Mueller-Bieniek, M. Moskal-del Hoyo *et al.* 2019) have provided evidence for the cultivation of wheat and barley, along with weeds like *Bromus, Chenopodium* and *Galium* often associated with cultivation. Well-preserved faunal remains show an animal economy in which domestic cattle were the major constituent, along with a much smaller number of sheep and goats, a very small number of pigs, and almost no wild mammals (P. Bogucki 1982; M. Osypińska, R. Abłamowicz 2019; A. Marciniak 2020; E. V. Johnson *et al.* 2022). Bovine milk lipid residues document dairy production (M. Salque *et al.* 2013). The relationship of the principal domestic taxa from sites in southeastern Kuyavia is shown in fig. 2.

The Linear Pottery economy should have had an impact on the landscape, but it does not appear to have caused significant changes in the surrounding vegetation. Two explanations are possible. First, cultivation and stockherding may have been practiced to such a small degree that small alterations in the

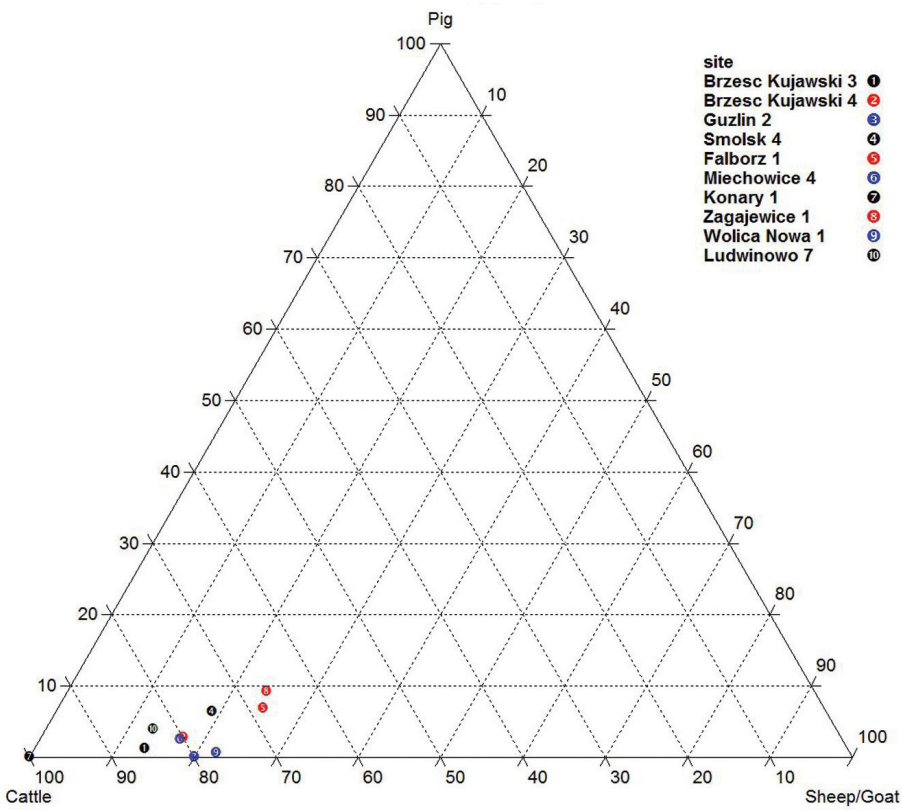

Fig. 2. Ternary plot of numbers of identified specimens of principal livestock species at Linear Pottery sites in southeastern Kuyavia, based on analyses by P. Bogucki and D. Makowiecki (reported in R. Grygiel 2004) with the addition of Ludwinowo 7 (E. V. Johnson *et al.* 2022).

Ryc. 2. Diagram trójskładnikowy, zawierający liczbę zidentyfikowanych przedstawicieli głównych gatunków zwierząt należących do żywego inwentarza, występujących na stanowiskach kultury ceramiki wstęgowej rytej na południowo-wschodnich Kujawach, na podstawie analizy P. Boguckiego i D. Makowieckiego (opisane w R. Grygiel 2004) łącznie z Ludwinowem 7 (E. V. Johnson *et al.* 2022).

local vegetation would have quickly regenerated and effectively would not appear in the pollen evidence. Second, the Linear Pottery communities may have taken advantage of existing breaks and clearings in the vegetation and may not have needed to transform the primeval forest much further. The traditional image of a Linear Pottery working landscape with settlements surrounded by cleared fields purposively carved from the forest probably is incorrect when it comes to the lowland zone.

Purposive vs. Opportunistic Deforestation

Tony Brown (1997) drew a distinction between "purposive" and "opportunistic" deforestation. Purposive deforestation involves deliberate felling of trees to create openings, the traditional model of Neolithic land clearance. Human action is the cause of deforestation and its maintenance over time as clearings are exploited for cultivation, grazing, and settlement. Opportunistic deforestation, on the other hand, takes advantage of natural breaks in the forest, perhaps expanding them but not felling many additional trees. These distinctions are presented in fig. 3.

The lowland forests encountered by the first Linear Pottery farmers would have had many natural openings resulting from windfalls and diseased and dying trees. Additionally, prime suspects as a agents in forest modification would be beavers, whose bones are found at many sites. Use of

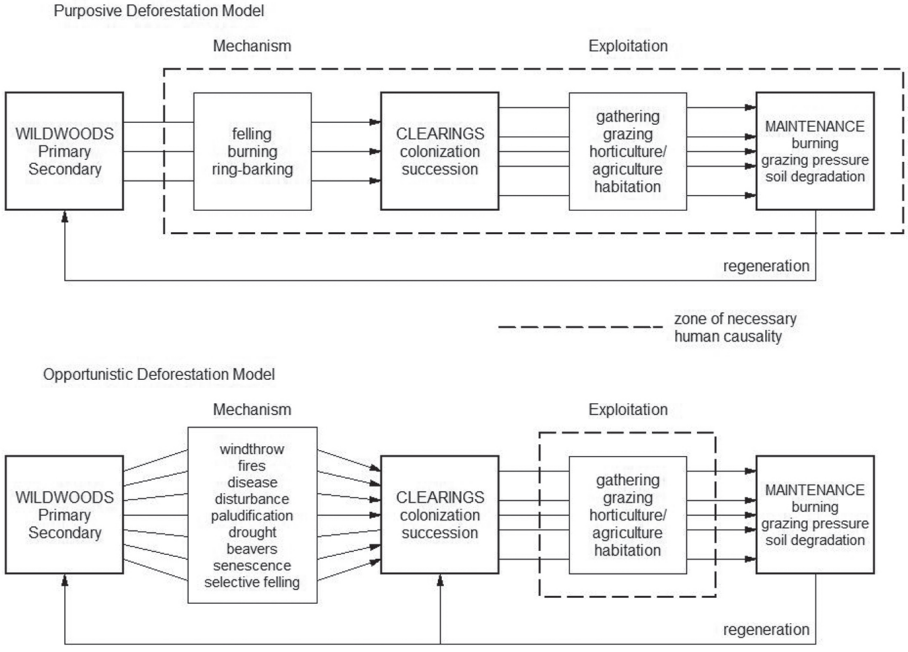

Fig. 3. Models of "opportunistic" and "purposive" deforestation (after T. Brown 1997).
Ryc. 3. Modele „oportunistycznego" i „celowego" wylesienia (wg T. Brown 1997).

pre-existing openings would also have dampened signals of land clearance in the palaeoenvironmental record since there would not have been a sudden alteration in pollen-producing vegetation. Along tunnel valleys and other glacial landforms would have occurred what W. Verboom (1977) called "zones of weakness" where tree growth was thinner and easier to clear.

Cattle, sheep, and goats could be grazed on forest-floor and understory vegetation at low stocking rates. it is indeed possible to keep small numbers of livestock in a forested environment (*e.g.* S. N. Adams 1975). Many years ago, the author made the rough estimate of a stocking rate of 1 cow/1 hectare/1 year (P. Bogucki 1982), requiring approximately six square kilometers of forest to feed 50 cattle, which he thought would have been the minimally-sustainable herd that could be kept by a Linear Pottery community. The palaeoenvironmental footprint of small-scale forest grazing would be minimal, perhaps even invisible.

Another marker of the opportunistic character of the Linear Pottery lowland settlements can be seen in the role of *Chenopodium album* (fat hen) at Ludwinowo 7 and, to a lesser degree, Smólsk 2/10 (A. Mueller-Bieniek *et al.* 2016; A. Mueller-Bieniek, P. Bogucki *et al.* 2019). Ludwinowo 7 has already been mentioned as an example of a multi-phase settlement with many houses. An unusual feature of its archaeobotanical assemblage is the high proportion of seeds of *C. album* in proportion to cultivated crops, in such a quantity that indicates its collection was an intentional practice rather than incidental mixture, possibly providing an important source of food. *C. album* would have been found in openings in the lowland forest, and farmers expanding these openings would have made it flourish profusely.

The Linear Pottery Working Landscape

It is possible to propose a speculative model of the working landscape of Linear Pottery pioneer farmers in the Polish Lowlands with the following characteristics:

- Except in specific concentrations such as along the Vistula escarpment in Kuyavia, relatively dispersed settlements with minimal architectural elaboration and very few burials, located along tunnel valleys and other relic glacial features;
- Natural openings used opportunistically for fields and pasture with additional purposive clearance in "zones of weakness";
- Natural forest understory vegetation modified by grazing.

Such a model would be consistent with the scale of settlements visible in the archaeological record and the fact that anthropogenic changes are virtually invisible in the palaeoenvironmental record.

Multi-generation settlement requires households capable of producing multiple generations of inhabitants. With a few exceptions, Linear Pottery pioneer households of the Polish Lowlands may not have met this specification. Pioneer households are often skewed from the norm. They may have unsustainable imbalances in gender and age, such as many young males and few women. With such imbalances, pioneer households can be difficult to sustain from one generation to the next. Migrations can also produce a reverse stream of unsuccessful migrants. Without consistent multi-generation occupations, it is not possible for cumulative landscape impacts to cause a dramatic transformation of the wild landscape into a persistent working agricultural landscape. That would have to wait.

Frontier Settlements of the Brześć Kujawski Group

The mid-fifth millennium BC saw a dramatic elaboration of lowland Neolithic settlement. Many lines of evidence allow us to infer that transformation of the working landscape was equally dramatic. Settlements of the Brześć Kujawski Group of the Lengyel Culture were established between 4700 and 4100 BC in essentially the same areas where Linear Pottery settlements had existed several centuries earlier, clearly part of the same Danubian tradition.

Settlements of the Brześć Kujawski Group share several features. The most prominent are timber longhouses 20–30 meters long, narrow at

the northernly end and wide at the southernly end, defined by bedding trenches rather than individual postholes and oriented NNW–SSE. A large settlement may have 30 or more houses, while other settlements may have a dozen. Many contain a single interior pit, oblong in plan and offset east of the central axis in the middle of the house. Their function is unknown, but they are commonly termed "cellars" (P. Bogucki, R. Grygiel 2022). Outside the houses, large pits provided clay for plastering walls and were subsequently filled with rubbish. Other pits were used for storage and eventually rubbish disposal.

Among the longhouses are skeletal burials. They sometimes occur in groups of 2–5 individual grave pits, providing additional evidence for settlement persistence. Bodies were typically (but not always) in a contracted position with heads pointing toward the south or southeast, with men lying on their right side and women on their left. Many skeletons bear evidence of dietary stress and violence (W. Lorkiewicz 2012).

The areas of Neolithic settlement in the lowlands were much more populated during the fifth millennium BC than we thought 40 years ago. Instead of occasional multi-longhouse settlements like Brześć Kujawski along with a few single-longhouse sites that simply echoed the Linear Pottery pattern with greater "strategic" permanence (P. Bogucki 1979), we now see a thickly-settled landscape. Areas previously thought to lack Neolithic settlement in unoccupied zones between major settlements now have been shown to contain dense concentrations of sites. Brześć Kujawski-type settlements are found in the same landscape zones as Linear Pottery settlements, specifically associated with sub-ice channels and other such glacial features. Many (but not all) sites show evidence of prior Linear Pottery occupation. The difference lies in long-term commitment to settlement locations reflected by multiple longhouses constructed over several building phases, multiple burials, and quantities of rubbish indicating sustained habitation.

Sites of the Brześć Kujawski Group yield substantial samples of faunal remains (*e.g.* P. Bogucki 1982; 2008; K. Waszczuk 2015; A. Marciniak 2022). Domestic animals typically comprise over 90% of identified mammal bones. Unlike cattle-dominated Linear Pottery samples, the animal economy of the Brześć Kujawski Group saw an increased role for sheep, goat, and pig

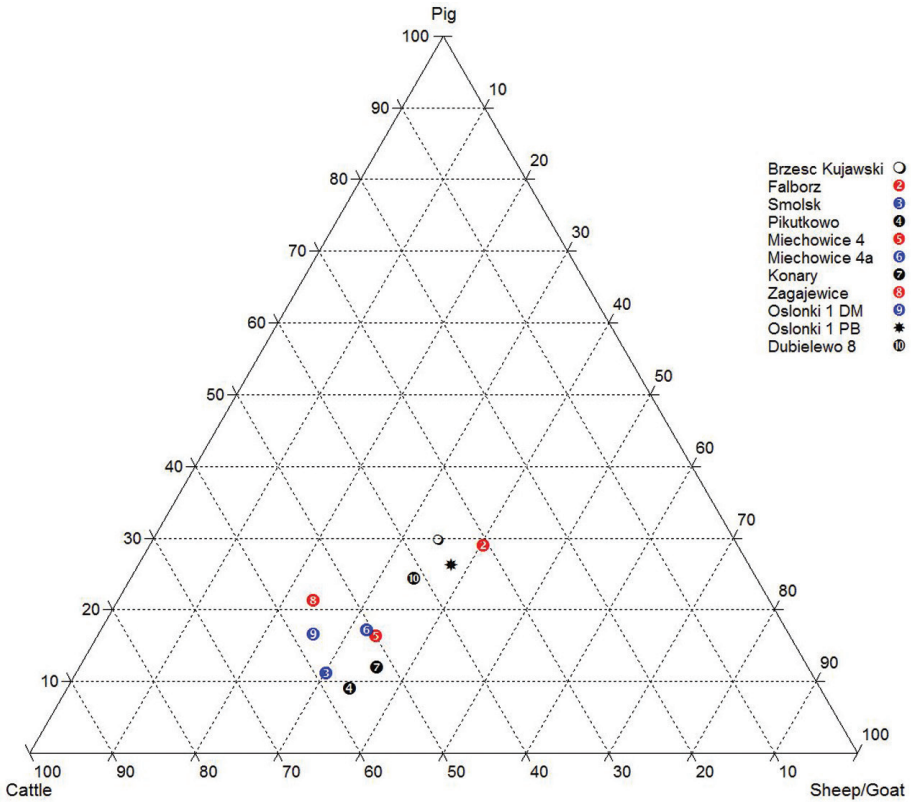

Fig. 4. Ternary plot of numbers of identified specimens of principal livestock species at sites of the Brześć Kujawski Group in southeastern Kuyavia, based on analyses by P. Bogucki and D. Makowiecki (reported in P. Bogucki 2008) with the addition of Dubielewo 8 (K. Waszczuk 2015).
Ryc. 4. Diagram trójskładnikowy, zawierający liczbę zidentyfikowanych przedstawicieli głównych gatunków zwierząt należących do żywego inwentarza, występujących na stanowiskach grupy brzesko-kujawskiej na południowo-wschodnich Kujawach, na podstawie analizy P. Boguckiego i D. Makowieckiego (opisane w P. Bogucki 2008) łącznie z Dubielewem 8 (K. Waszczuk 2015).

(fig. 4). When specimens are identified to species, goats typically outnumber sheep. In addition, red deer and roe deer, wild cattle, wild pig, wild horse, bear, and beaver were present in the surrounding ecosystem. Fish, turtles, and waterfowl are represented more abundantly than at Linear Pottery settlements, particularly in samples from large sites such as Brześć Kujawski and Osłonki (P. Bogucki 1982; 2008; D. Makowiecki 2003).

The working landscape of this diversified animal economy would have been much different from the Linear Pottery cattle economy. Each livestock species has its own dietary requirements. Perhaps the most interesting is the significant presence of goats, whose browsing consumes leafy vegetation more aggressively than grazing by sheep and cattle. Evidence for beaver skinning at Brześć Kujawski and Pikutkowo indicates that adjacent Lake Smętowo was home to a substantial colony. An increase in the number of pond tortoise remains suggests a very favorable environment for their propagation.

Botanical samples of the Brześć Kujawski Group have yielded quantities of carbonized wheat and barley, including substantial amounts of chaff (A. Bieniek 2007; A. Mueller-Bieniek *et al.* 2016). Moreover, they contain a comprehensive sample of weed taxa that corresponds to the list of species cited by Amy Bogaard (2004) as evidence for intensive garden cultivation in early Neolithic Europe. The fields were clearly used long enough to generate rich weed assemblages. Of particular note are many grains and awns of feather grass, *Stipa pennata*, a xerothermic species. It is unsuitable for fodder or human consumption, and A. Bieniek suggests it might have been used in roofing or insulation. Feather grass normally grows in habitats that are not natural to Kuyavia, and the presence of this species in such a quantity suggests Neolithic maintenance of open habitats.

Environmental Data from Osłonki

Segments of the pollen cores from the Osłonki area corresponding to the occupation by the Brześć Kujawski Group contain corroded sporomorphs caused by the inwash of mineral particles, making them unsuitable for

reconstructing the species composition of the surrounding vegetation (D. Nalepka 2005; 2011; P. Bogucki *et al.* 2012). Yet the inwash of mineral particles is significant, for it shows the extent to which the surrounding landscape was exposed to erosion. Along the margins of the lakes, deltas of alluvium represent erosion from adjacent fields. Sandy lenses in the middle of the basins have been interpreted as wind-deposited soil that accumulated on winter ice and then settled to the bottom when the ice melted.

The most telling evidence for substantial local landscape modification at Osłonki comes from malacological and cladoceran evidence (S. W. Alexandrowicz 2008; M. Gąsiorowski 2008; summarized in P. Bogucki *et al.* 2012). The presence of land snails among an otherwise aquatic snail population in layers containing charcoal and mineralogical material indicates delivery of sediment from nearby land surfaces into the lakes. Meanwhile, cladoceran species that prefer clear water disappear in the mineralized layer to be replaced by those that tolerate, even prefer, a high level of nutrients. This is taken to indicate an intensification of eutrophication caused by increased inflow of nutrients, probably caused by the dumping of rubbish and human and animal wastes.

Frontier Household Demography and Environmental Impact

During the fifth millennium BC, arable land was abundant in the lowlands. Farming households in such an environment would have had a great incentive to have children, and within 20 years, enough of these children would have grown up to form new households with yet more children. Thus, we can hypothesize that we are dealing with communities in which full household developmental cycles were repeated and propagated.

On an agricultural frontier, such multi-generational settlements can have a dramatic and persistent impact on the environment, a process that has been studied in Amazonia (S. Perz, R. Walker 2002; S. Perz 2003; E. F. Moran, S. D. McCracken 2004 among others). Based on this literature, it is possible to draw a very general model of landscape development on a farming frontier:

1. Initial clearance is followed by maintenance of deforested land for cultivation.

2. As children become able to work by tending animals, there is an increase in livestock and grazing.

3. Second-generation households initiate a new round of forest clearance, with old fields used for pasture.

4. The cumulative impact over many generations results in extensive landscape modification.

The key point is that the household developmental cycle directly drives the development of the working landscape in a forested agricultural frontier, and if cycles proceed *seriatim* then the impact on the natural landscape is significant.

The Working Landscape of the Brześć Kujawski Group

Based on the above considerations, it is possible to propose a speculative model of the working landscape of the Brześć Kujawski Group in the Polish Lowlands. The evidence suggests widespread purposive deforestation and maintenance of open areas for pasture and cultivation. Some areas must have been so thoroughly cleared and tilled that soil was washed and blown into the adjacent lake basins. The construction requirements of longhouses would have made further demands on local timber. Browsing by goats added to the environmental impact.

Beyond the cleared area, we can speculate further that forest floor and understory vegetation would have been modified by grazing of cattle and sheep as well as by the rooting of pigs. Furthermore, the firewood demands of the settlements would have caused virtually all available deadwood to be collected, further modifying the forest floor vegetation. Paths and trails connecting settlements created corridors and facilitated further landscape modifications along their routes.

Yet, as Dorota Nalepka (2011, 125) has stressed, it is likely that this impact did not extend beyond the immediate vicinity of the major settlements.

Land clearance and erosion had an intense local character not felt on a regional scale. Moreover, similarities between the Osłonki pollen profile above the mineralized layer with that below it indicate that the surrounding vegetation recovered its original composition after occupation by the Brześć Kujawski Group ended.

Conclusion: Linear Pottery Pioneer Households vs Lengyel Frontier Households

The combination of archaeological and environmental information permits identification of two different types of working landscapes. During the sixth millennium BC, settlements of the Linear Pottery culture were characterized by low-impact *pioneer* land use with largely opportunistic deforestation carried out by possibly incomplete or demographically-skewed households. Settlements of the Brześć Kujawski Group, on the other hand, were characterized by high-impact *frontier* land use with purposive deforestation and the maintenance of fields and pastures. The transformation of the landscape was carried out by households that were functioning reproductive units, over successive developmental cycles. Each developmental cycle triggered further land clearance and adjustments in the household economy. Multiple cycles in parallel and in sequence amplified the impact on the local environment and caused the working landscape to be extended and remodeled over time.

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